View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Elsevier - Publisher Connector

Available online at www.sciencedirect.com

SciVerse ScienceDirect

Physics Procedia 33 (2012) 528 – 534

Physics Procedia

2012 International Conference on Medical Physics and Biomedical Engineering

The Design and Implementation of Aircraft Maintenance On-site Control System

Guilin Zhou,Huawei Zhang

IT Dept.,CSN Beijing Branch ,Beijing, China
zhougl@csair.com，zhanghuawei@csair.com

Abstract

Based on the desire of aircraft maintenance, combined with the situation in work, this paper present the design and implementation of aircraft maintenance system based dot Net. For a partial page refresh object, AJAX is used through the system. New technology is used in a creative way and will promote innovation and transformation of the business.

© 2012 Published by Elsevier B.V. Selection and/or peer review under responsibility of ICMPBE International Committee.
Open access under CC BY-NC-ND license.

Keywords:Aricraft Maintenance;On-Site Control; dotNet;AJAX;Innovation

1.System requirements

CSN Beijing Branch is a young company. At present which is confronting with a huge challenge for such a young Aircraft Maintenance team to undertake the maintenance work of CSN, whose landing or taking-off are more than 220 flights per day in the Beijing airport.

Heavy Aircraft maintenance task, flight time focusing on, varieties of aircraft types, less maintenance personnel and informatization technology lacking make up the main contradiction, so that missing-pickup the plane had happened by poor information before.

The traditional maintenance scheduling and the field production control process are as follows:

- The master MCC (maintenance control center) control personnel are responsible for monitoring the operation network, keep aircraft dynamic information acquired at all times.
- The vice MCC control are responsible to pre-assign tasks according to different aircraft types.
- Vice MCC control prepare the work-cards, and contact the workshop to get the work-cards through interphone.
- The workshop work-card person get all the cards, arrange production personnel to work.
- Workshop production personnel completed work, and signed the release order, keep MCC noticed through interphone.

Disadvantages exist in the processes are as follows:

1875-3892 © 2012 Published by Elsevier B.V. Selection and/or peer review under responsibility of ICMPBE International Committee.
Open access under CC BY-NC-ND license. doi:10.1016/j.phpro.2012.05.099

- Information transfer depends on the phone or interphone only, it is not retrospective.
- Make production schedule and get all work-cards ready completely dependent on artificial work, there is no scientific and unreasonable, information is not comprehensive so that the existence of artificial error will happen.
- Lack of the necessary information feedback. It is difficult to monitor the MCC production personnel work schedule.
- The change of the flight time inform system depends entirely on the MCC artificial monitoring, there is the possibility of notice leakage.

2.System design

2.1 Based on the information flow reengineering

By means of information, to make a reform in view of the traditional business processes:

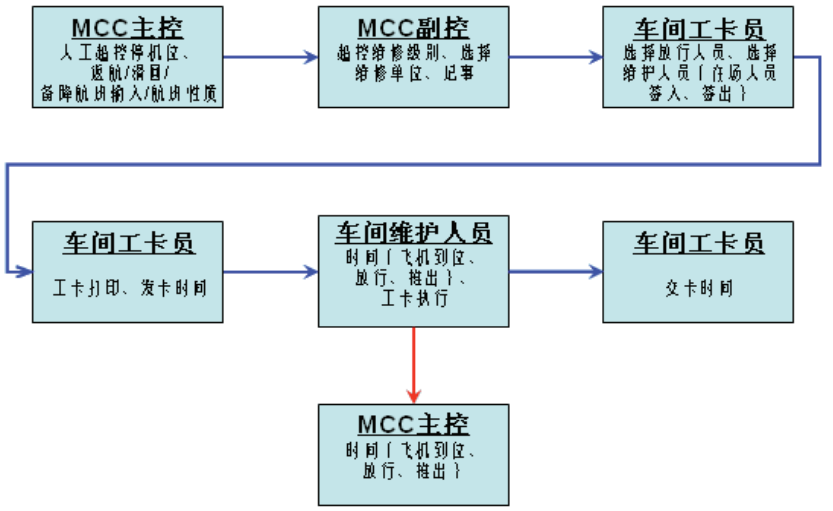


Figure 1. Operation Flow

- The system according to the plane's arrival and departure from SOC system dynamic data automatically matched up, and the information of gate position from the airport is also automatically filled in.
- The state of maintenance task underway of flights 4hours before and after will be delivered to MCC, and displayed with different colors to show the information that needed attention.
- The system according to the different types of aircrafts automatically pre- rationed tasks to corresponding workshops. MCC can make adjustment artificially.
- The person who manage the work-cards can dispatch the task by doubling click. The system automatically pop-up a personnel list to choose, the maintenance personnel and the one who has the ability of release will be separated automatically. The system of personnel following filtration: check-in staff, with the type of work capacity of the staff, with the corresponding level of maintenance ability of the staff; and the current mission personnel on the front row, has the mission of personnel in the back row, at the same time mark the place parking and send work time.
- The work-card person as long as double click the aircraft number corresponding to the work card column, the system automatically printed out the task list and corresponding to the work card. Task list has the following information: the plane information, flight information, berth and estimated arrival time, departure time, aircraft main part's number, trouble information in flight, etc.

- The Maintenance person gets work-cards, work-card person double click and fill into the work-card claimed time. Maintenance personnel reached the berth, and report to MCC through interphone, MCC will fill in the time of placement in place.
- After personnel signed release order, call MCC through the radio, and MCC will double-click the aircraft number and corresponding release time, which can be automatically filled into the system.
- The maintenance staff after finishing the work will return the work -card, work-card person double-click the return card time volume, and fill in it. It's the work all done.

2.2 Based on the color warning system

The above process of all time points and complete state system are in records, and through the corresponding control interface shows the corresponding post. If there are some individual key parts uncompleted or conflict with other berth need to remind or warn users, the system will adopt the program which based on the color scheme of warning. The warning system adopt international standard level 4 warning, from light to heavy in order as blue, yellow, orange and red. Users in the use of system, just pay attention to the four colors can not miss any key work, and will save human, avoid factitious mistakes.

level	type	content	show
1	blue	Tip message	high brightness flashing display
2	yellow	Tip message, but Without intervention。	
3	orange	warning，please Special attention。	
4	red	Emergency information, must immediately take measures。	

Figure 2. Warning Of System

2.3 System database design

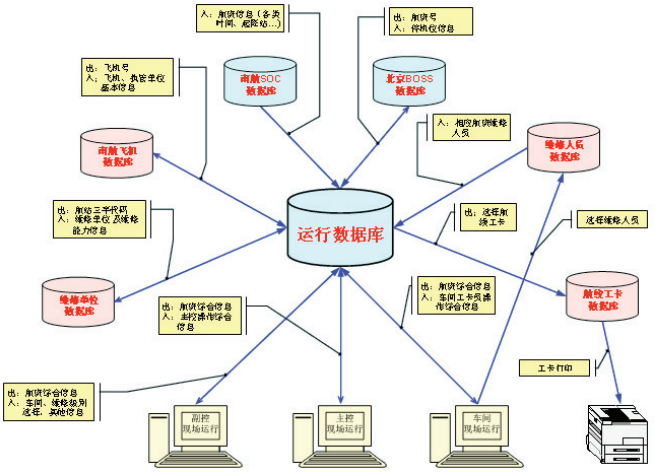


Figure 3. View Of Operation

The core system database is operation database, for this system is maintenance control system, need to other related system and the data support, so that would involve a series of data interface. As shown in figure, first need the support of the China Southern Airline's SOC data, the system of the aircraft for the use of the flight dynamic data mainly comes from CSN; Besides, the ground operation service system should exchange with BOSS data; China southern airlines plane databases with the basic information of the aircraft and the main materials package number; Repair units provide each terminal database course has the maintenance qualification information; Provide maintenance personnel database maintenance personnel ability and whose passport information; Airline work-card database can provide the plane of line maintenance work-card. The system is based on the business logic organization of all kinds of data. For users, it is a complete view of the data, covering the user work flow and all the main information needed.

2.4 Architecture of system

The system contains four parts: system site operation, business logic layer, data access, data interface layer, database server (see chart 4)

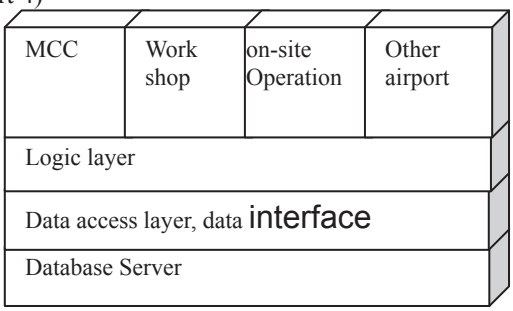


Figure 4. Architecture of System

The on-site operation are the main functions of the information transfer and field control, mainly including MCC monitoring page, workshop monitoring page and on-site management page, the station running monitoring page, realize the site operation transmission among pages rapidly, accurately to support the field staff monitor aircraft operation state, production scheduling, the workshop participants work dispatching and workshop work monitoring, etc.

Business logic layer, mainly be responsible for the system of data integration, the flow of system, provide backend maintenance etc, will make the data extracted from other systems integrated, realize the corresponding matching algorithm, such as sorting algorithm, and support the maintenance personnel background data, provide the control personnel, fleet and other detailed information.

Data access layer, data interface layer provides the data of efficient access. The database server SQL Server2005 provide support for data storage.

3.Technique implementation

The system USES the Microsoft.net technology, using c # language through the VisualStudio2008 R1 realized. The system is to use the B/S (browser/server) architecture of the Web system, in order to strengthen the operation and interactivity and user experience, the system uses a lot of Ajax and JavaScript technology.

3.1 Based on the ADO.net Entity Framework data access layer

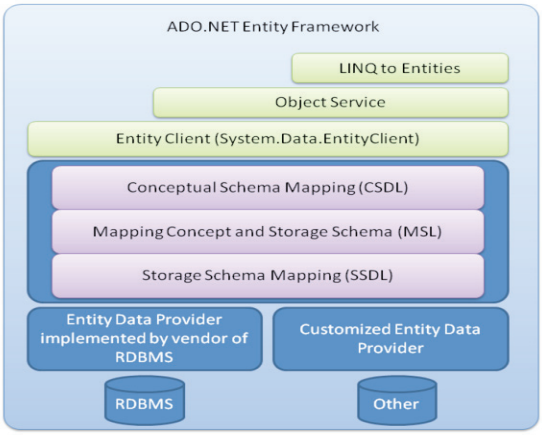
Run by Microsoft's database SQL Server 2005, Microsoft.net provides a series of data access

technology, especially on the SQL Server database made optimization. Among them the ado.net Entity Framework is the latest to ado.net based out of the development object-relational Mapping (O/R Mapping) solution (see chart 5).

Using the Entity Framework abstraction of data structure way, each database objects are converted into application object (Entity), and data fields are converted to attribute (property), the conversion relation for combining attributes (association), let the database of the E/R model of completely into object model, so make the program designers can use the most familiar programming language to invoke the visit. And in the abstract structure under, is highly integrated with the concept of the corresponding structure layer, and corresponding layer and storage layer, and support the Entity Framework data provider (provider), let the data access work complete smoothly [1-2].

- Concept layer: be responsible for upward objects and attributes of the show and access. It is defined the concept of Object Model. Let the upper application be as the object-oriented approach as to access data, Conceptual layers structure uses CSDL (Conceptual Schema Definition Language) Language Definition.
- Corresponding layer: will put the concept of above and the storage of layer under and data structure corresponding together. Corresponding layer structure is using MSL (Mapping Specification Language) Language definition.
- Storage layer: according to different database and data structure, and revealed the entity data structure body, and Provider together, responsible for the actual database access and SQL production. Storage layer structure is responsible for database management system (DBMS) corresponding to the data table Physical Mapping, it uses SSDL (Storage Schema Definition Language) Language Definition.

Figure 5. Components of System



3.2 Based on the logic of LINQ processing

LINQ (Language Integrated Query) is the leader in Visual Studio 2008. By LINQ technology, we can use a similar SQL syntax to check any form of data. So far the support of the data sources has LINQ SQL Server, XML and data in memory set. Developers can also use the expansion framework add more data sources, such as MySQL, Amazon and even is Google Desktop.

Use LINQ to fully object-oriented approach operation entity object model from the object in the set, and meet the needs of the business logic [1, 2].

3.3 Based on the matching of flight number

Based on the aircraft number, the intelligent matching of arrival flights and departure flights into the airport is one of the key system logics.

The flight information get from the SOC leg is the basic unit, namely an arrival flight and a departure flight can be called a information respectively. The on-site control system is based on the plane's requirements, you need match them according to aircraft number. Take an arrival flight and one departure flight together as a complete flight information, the first half of this information is arrival flight data, the last half of the departure flight data. For this reason, we design the way of matching algorithm according to the flights are as follows:

- A plane for a day only one flight. On the flight as the foundation, make a new information in the system.
- A plane for a day has many flights.Usually it can be divided into several situations:
  1). If no flight before, take departure flight as the foundation, make a new information.
  2). If no subsequent flights, take the arrival flight as the basis, make a new information.
  3.)Other situation, take both an arrival and departure flights as the foundation, creating a flight data information includes arrival and departure data.

Take one plane for example, the system from the SOC extract the plane flight number fresh today, and is expected to take off in time ascending order, judge the first flight is arrival or departure, if departure, by the flight as the foundation, in the system make a new information. If departure flight, judge it whether has a subsequent flight or not, if no, take the flight as an independent information stored in the system; If yes, in the recent arrival flights and departure flights date, after matching coexist into the system; And then judge whether there are arrival or departure flights or not, so circulates, until all flights complete the matching.

In order to better pay attention to current flights information, how to sort the flights is one of the important problems need to consider. The intelligent design system with the sorting principle of its flight's estimated arrival time and departure time. The plane that still in flight according to the estimated arrival time; after its arrival the estimated departure time is expected to the principles of sequence, the sorting algorithms, to ensure that the current flight informations orderly presented before the users. Its core is, to set a time variable, for the arrival flight , will set time variable to be the estimated arrival time, or, the estimated departure time.

3.4 The across date flight order processing

In the system, it is a part of special flight need special attention, that is cross date flights. To this kind of flight, first needs to solve scheduling problem, we adopt the following solutions:

In system set a time points, for example, three in the morning, in the calendar days on the same day, make a judgment between the relationship and the current time, if the current time more than time points, then take the day's flights and calendar day tomorrow's flight information, and tomorrow's flight time will plus 24 hours; If the current time less than time points, then take calendar days of flight and the day yesterday flight, and the flight time today plus 24 hours. This would solve the problem of flights across the date order.

3.5 Based on AJAX and JavaScript page optimization

In order to improve the user experience, achieve similar to the desktop system of quick operation, the system USES a lot of AJAX and JavaScript technology.

Because the system real time demand is higher, we use the Ajax technology, with JavaScript sends a XmlHttpRequest to the server, and then returned with the data through the JavaScript pages of the

realization of local refresh, reduce and server exchange data pressure, reduce bandwidth, and improve the system efficiency [3-4].

The system through the rewrite Render method, create public jump page method with JavaScript technique such as double click, similar to the desktop system fast operation. Users can easily through the click, double click view messages such as important, and system interactions, such as the take-off and landing at the airport, flight information fresh detail parameters, etc.

Application of the realization of the suspension of JavaScript navigation bar, not only convenient user operations, more make integral interface is simple and clear, improve the user experience.

4.System prospects

As Aircraft maintenance on-site control operation system succeed in development and promotion, and lay a foundation to further realize the ground operation control overall information. Surely, The system will inject new vitality and vigor for civil aviation informatization.

References

[1] Bill Hamilton. ADO.NET 3.5 Cookbook[M]. Beijing: China Machine Press，2009

[2] Jun Zhang. ADO．NET Database Development and Application[M]. Beijing: China Machine Press，2008

[3] Chanmin Zhang. ASP.NET3.5AJAX Client Programming 166 Examples[M]. Science Press，2009

[4] Brett McLaughlin. Head Rush Ajax[M]. Nanjing: Publishing House of Southeast University，2008